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AN AUTOMATIC ELECTRIC MAN-HOIST FOR SLOPES OR INCLINES

BY

S. H. ASH AND E. M. BROOKS

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AN AUTOMATIC ELECTRIC MAN-HOIST FOR SLOPES OR INCLINES 1/

By S. H. Ash 2/ and E. M. Brooks 3/

Many of the hoisting slopes at the mines in the State of Washington are driven on extra steep dips. To facilitate hoisting they are driven wide enough to provide two tracks. The cars are handled by high-speed, first-motion electric hoists and the trips run in balance.

The State mining laws 4/ provide that special man-cars be provided on slopes of 20° or more and that no one be allowed to ride while any loaded car is being hoisted in any slope in a mine. Obviously, in addition to the fact that it is more or less hazardous to ride while an empty trip is being hoisted, considerable hoisting time is lost during the day if some one has to ride the trips in the slope.

Owing to the locations of pumps and various types of equipment, more or less travel is required up and down the slope. Not only to provide a proper safety factor but also to comply with the law, some other means of transportation in another passageway is desirable. This is sometimes recognized in large mines by providing separate hoisting shafts, or slopes, and necessary equipment, which are used for transporting men and material. The handling of material in itself would justify the system in most large mines.

The following description of an automatic electric man-hoist was prepared from data furnished through the courtesy of Mr. Thomas Murphy, superintendent of the Northwestern Improvement Company's mines in the Roslyn-Cle Elum coal field.

The special features of this hoist are that no hoistman is required and its operation is always under the control of the person or persons riding the trip.

The hoist was installed at mine No. 5, Roslyn, Washington, to provide a means of entering and leaving the mine on idle days or at night when no hoistman was on duty and to make it unnecessary to use the main hoist for a man trip during working hours. It has been in operation for about two years and has given very satisfactory service.

1/ The Bureau of Mines will welcome the reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6301.

2/ Mining engineer, U. S. Bureau of Mines, Safety Station, Seattle, Wash.

3/ Electrical engineer, Northwestern Improvement Co., Roslyn, Wash.

4/ Sections 62, e and 175, State mining laws, 1927.

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The hoist, with all accessories, is housed in a concrete building 200 feet back from and in direct line with one of the main airways. One car with a capacity of six men operates over a distance of 1,200 feet on a 38° pitch.

The wiring details of the electric circuits which control the operation of the hoist are shown in Figure 1-a.

The hoist is driven through a worm gear by a 500-volt shunt-wound direct-current motor at a car speed of 120 feet per minute. A gravity friction brake with magnetic release is mounted on the motor shaft and is wired in multiple with the motor field coils. The hoist drum is also equipped with emergency friction brakes, which operate by gravity and are released, in case of overspeed, by the governor geared direct to the drum shaft. When these brakes set the control circuit is opened at contact 2E-2C and the motor stops.

If the descending car meets some obstruction and is stopped, the hoist continues to run and unwind the rope. To guard against this occurrence, a weighted sheave wheel rides the rope 4 feet from the drum, and if the rope becomes slack the rider drops downward and opens the contact 2C-2B which stops the hoist.

Limit switches, S1 and S2, are located on the hoist indicator, which is connected to the drum shaft through sprockets and chain. The pointer P indicates the position of the hoist at all times.

The control wires, L1, L2, L3, are No. 8 semihard drawn copper supported from the roof, 3 inches apart, over the center of the track and about 4 feet above the car floor. Pilot lamps are located at the top and bottom landings and, if burning, indicate that power is available and that the control wires are in a safe condition. If the lamp across L1-L2 is "out" the hoist is in operation and traveling downward. Likewise, if the other lamp is "out" the hoist is traveling upward.

As the control wires were located in return air it was necessary to use a low potential to comply with the mining laws. This was done by aid of a bank of lamps, as shown in the drawing, enough lamps being connected in parallel to give a potential across the control wires of 24 volts.

The relays A and B are operated by connecting lines L3 and L2 and L1 and L2, respectively, by means of a "rapper" carried on the car; or, if not available, the blade of a screwdriver or a brass-bound rule is just as effective.

The pilot lamps are two candlepower 18-volt automobile lamps, with a little wire resistance in series. The total resistance is high enough that the relays are not affected and that the pressure across the lamps is reduced below normal, which gives them a long life.

The operation of the equipment is as follows: Assume an employee comes to the bottom landing and desires to go up and the car is not there. Pilot lamp L2-L3 is burning and the other is "out," indicating that the hoist is traveling up so that he must wait until the car has reached the top landing which is indicated when both lamps burn. He then bells the trip down by "shorting" wires L1-L2. The car

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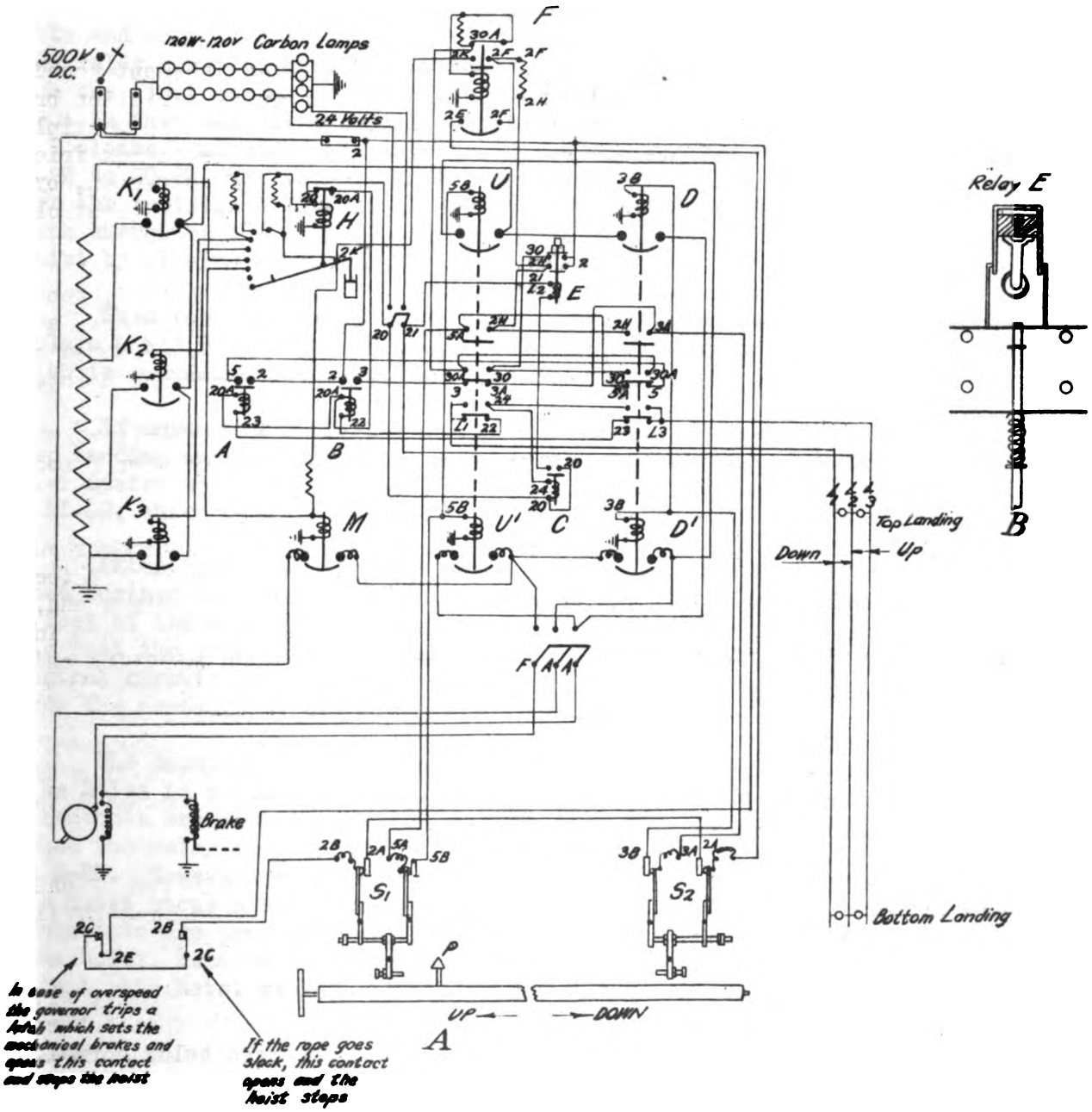

Figure 1.- Details of automatic electric man-hoist, No. 5 mine, Roslyn, Wash.

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descends and stops automatically at the landing. He then gets on the car and, reaching up, bells the car up by "shorting" lines L2-L3. Placing a "short" on lines L2-L3 energizes line 23, which operates relay A. This closes the relay contacts and energizes line 5, which in turn energizes line 5A through the interlocking relay contacts operated by contactors D and D1. Line 5A energizes line 5B through the limit contact 5A-5B on the indicator and contactors U and U1 are close Line 30A is then energized from 500-volt control wire 2 through the relay E, and relay F closes. Line 2E, which is energized through the contacts 2-2A to 2A-2B to 2B-2C to 2C-2E, now energizes 2F. Contactors U and U1 are now held closed through the resistance 2F-2H. Line 2K is also energized by the contacts of relay F, which energizes the contact-making arm of H. This arm rises slowly and starts the hoist by closing contactors M, K1, K2, and K3.

When the arm starts it opens contact 20-20A, which deenergizes line 20A. and relays A and B can not operate. However, the control is transferred to relay C, which is connected to L1 through line 24.

If anyone is traveling toward the top, the car automatically stops at the top landing and the indicator pointer P operates contact 5A-5B. Should the traveler desire to stop somewhere between landings, he reaches up and "shorts" lines L1-L2, which operate relay C. Relay E then operates and the hoist stops.

After the hoist stops automatically at the top landing, it can not be operated further in the "up" direction. However, it can be belled down, and after a few feet of travel the contact 5A-5B is restored. If the car for any reason travels past the landings, the emergency contacts 2-2A or 2A-2B will be opened and the control circuit cut off. The hoist is then out of service until an attendant restores the contacts by operating the hoist from the control board.

The construction of relay E is shown in the enlarged sketch (fig. 1-b). When the hoist is stopped between landings by the operation of this relay, the lower contacts are closed before the upper contacts open. The hoist does not stop when the relay is energized, the contactors being held in by the circuit across 2-2H. However, the instant the "rapper" is removed the relay is deenergize and the hoist stops and can not be operated again until the top contacts are close These contacts are provided with a time delay. This time delay was necessary to stop the hoist, because if the "rapper" were left on the control wires for more than an instant, the hoist would stop and immediately start again in the reverse direction.

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